

Figure 1

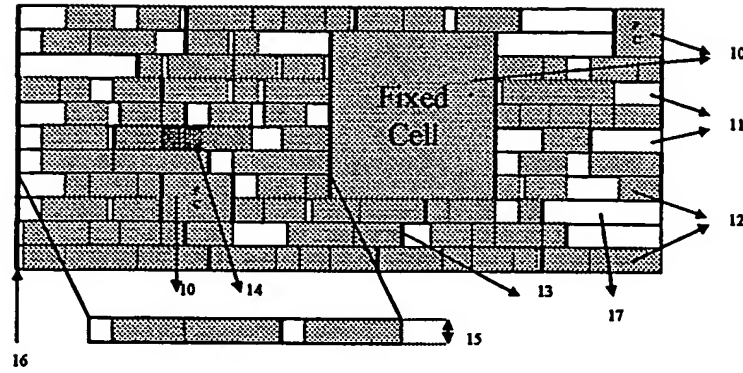


Figure 2

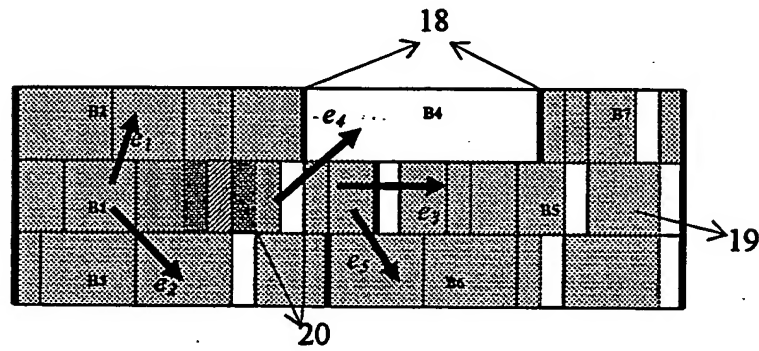
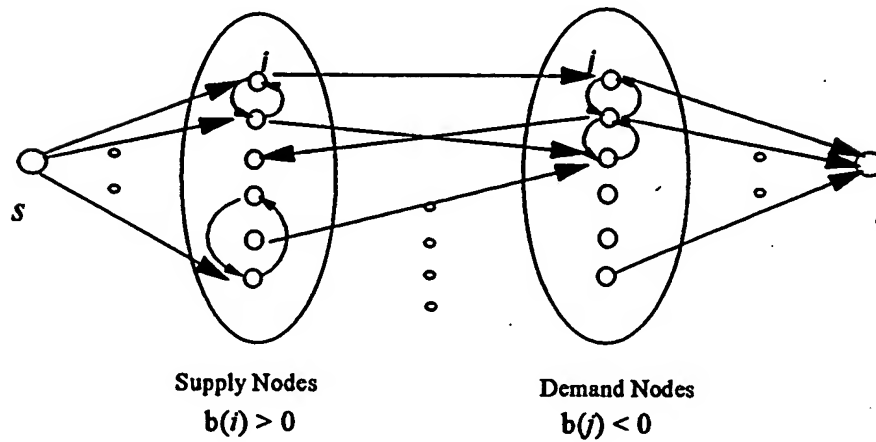


Figure 3



$\forall i \text{ if } b(i) > 0,$
 $\text{Cap}(e_{si}) = b(i)$
 $\text{Cost}(e_{si}) = 0$

$\forall i \neq s, j \neq t,$
 $\text{Cap}(e_{ij}) = \text{Infinity (Large Int)}$
 $\text{Cost}(e_{ij}) = K_{e_{ij}}$

$\forall j \text{ if } b(j) < 0,$
 $\text{Cap}(e_{jt}) = -b(j)$
 $\text{Cost}(e_{jt}) = 0$

\forall : Notation represents the meaning "For Every Element"

\in : Notation represents the meaning "Element of"

Figure 4

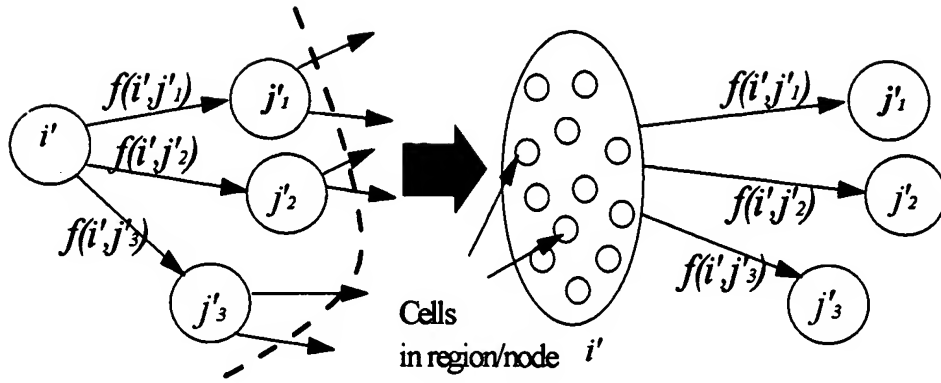
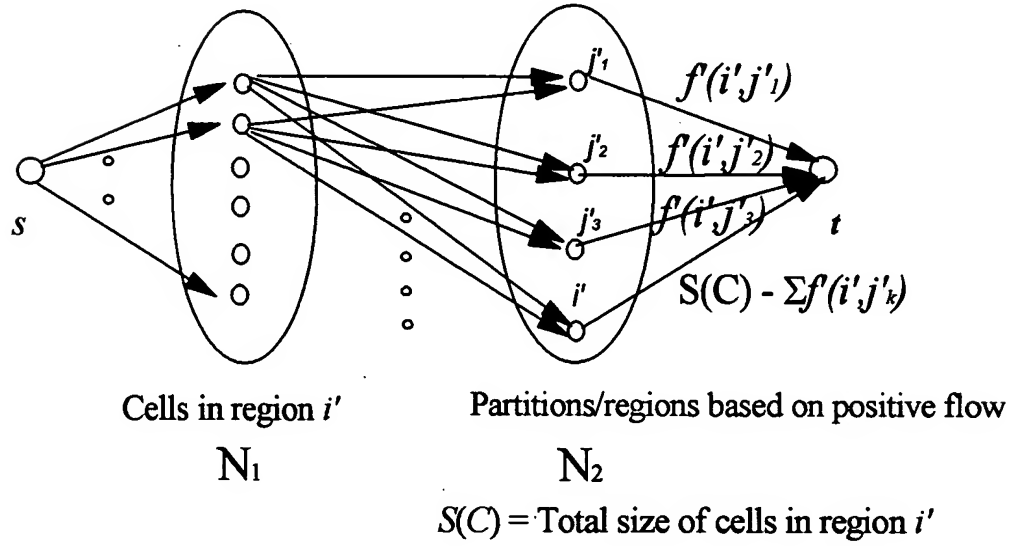


Figure 5



$$\forall i \in N_1$$

$$\text{Cap}(e_{si}) = 1$$

$$\text{Cost}(e_{si}) = 0$$

$$\forall i \in N_1, j \in N_2,$$

$$\text{Cap}(e_{ij}) = 1$$

$$\text{Cost}(e_{ij}) = \text{Cost of moving}$$

$$\text{cell } i \text{ to region } j$$

$$\text{multiplier } \mu_{ij} = \text{size of cell } i$$

$$\forall j \in N_2$$

$$\text{Cap}(e_{jt}) = \text{flow to region } j$$

$$\text{Cost}(e_{jt}) = 0$$

\forall : Notation represents the meaning "For Every Element"

\in : Notation represents the meaning "Element of"

Figure 6

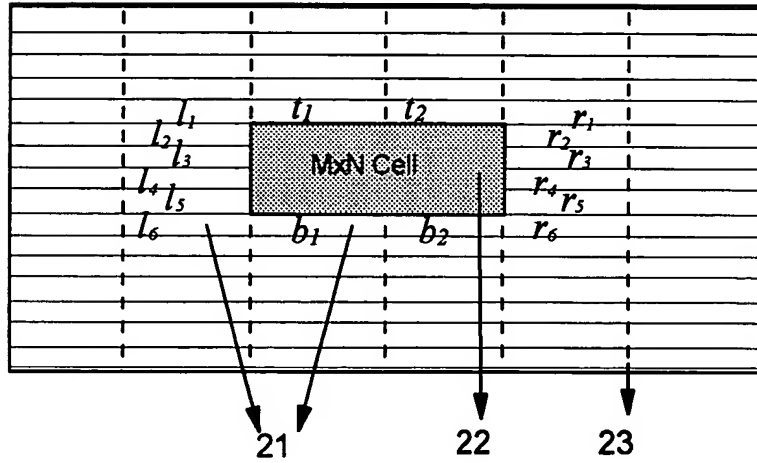
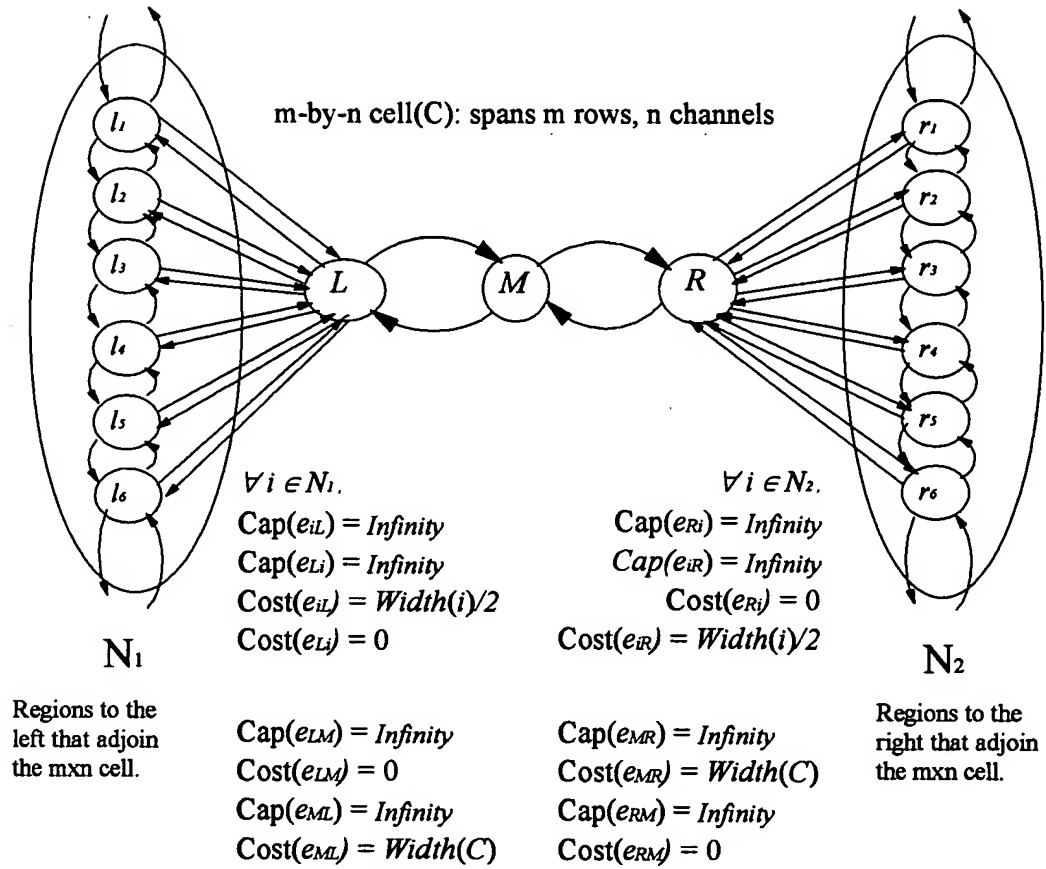


Figure 7



\forall : Notation represents the meaning "For Every Element"

Figure 8

Placement_Aware_Region_Definition ()**Begin**

1 Build placement image

2 For each circuit row r in the layout **Begin**3 $scanline_x = row_xlow(r); last_region_boundary = row_xlow(r);$ 4 $leading_free_space = false;$ 5 $S =$ sorted list of cells in row r by increasing position along x -direction6 $c =$ first cell in sorted list S 7 while (c) **Begin**8 If ($xpos(c) > scanline_x$) **Begin**9 If ($xpos(c) - last_region_boundary > W$) **Begin**10 $p = create_region(r, last_region_boundary + W, last_region_boundary)$ 11 $scanline_x = (last_region_boundary + W)$ **End**

12 Else

Begin13 If ($is_fixed_cell(c) \parallel is_blockage(c) \parallel leading_free_space$) **Begin**14 $p = create_region(r, xpos(c), last_region_boundary)$ 15 $scanline_x = last_region_boundary = xpos(c)$ 16 $leading_free_space = false$ **End**17 Else if ($xpos(c) - scanline_x \geq 0.50 * W$ and $scanline_x > last_region_boundary$) **Begin**18 $p = create_region(r, scanline_x, last_region_boundary)$ 19 $last_region_boundary = scanline_x$ 20 $leading_free_space = true$ **End**21 Else $scanline_x = xpos(c)$ **End**22 **End**23 Else if ($xpos(c) == scanline_x$) **Begin**24 If ($is_fixed_cell(c) \parallel is_blockage(c)$) **Begin**25 $p = create_region(r, xpos(c) + width(c), scanline_x)$ 26 $scanline_x += width(c)$ 27 $last_region_boundary = scanline_x$ **End**28 Else if ($is_movable_cell(c)$) **Begin**29 If ($xpos(c) + width(c) \leq W$)30 $scanline_x += width(c)$

31 Else

Begin32 $p = create_region(r, xpos(c) + width(c), last_region_boundary)$ 33 $last_region_boundary = scanline_x$ 34 $scanline_x += width(c)$ **End** **End**35 $c =$ next cell in the sorted list S **End** **End** **End****End****Figure 9**

Global_Area_Migration_Graph ($G(V,E)$)**Begin**

1. $V = \{\text{regions}\}$, $E = \{\text{edge between neighboring regions}\}$
2. $\forall e \in E$, $\text{Cost}(e) = K_e$
3. $\forall e \in E$, $\text{Cap}(e) = \text{Infinity}$ (Large integer)
4. $\forall v \in V$, $\text{Size}(v) = \text{Total size of movable cells in } v$
5. $\forall v \in V$, $\text{Cap}(v) = \text{Total available space for movable cells in } v \text{ (i.e. region)}$
6. $\forall v \in V$, $b(v) = \text{Size}(v) - \text{Cap}(v)$
7. If $b(v) > 0$, v is a supply node.
8. If $b(v) < 0$, v is a demand node.
9. If $b(v) = 0$, v is a transshipment node.

End

\forall : Notation represents the meaning "*For Every Element*"

\in : Notation represents the meaning "*Element of*"

Figure 10

Generalized_Flow_Graph (region i')**Begin**

1. $N_i = \{\text{cells in region } i'\}, N_i = \{i'\} \cup \{\text{neighboring regions}\}$
2. $E = \{\text{edge representing cell-to-region assignment}\}$
3. $S(N_i) = \text{Total size of cells in } N_i \text{ (region } i')$
4. $\text{Smallest}(N_i) = \text{Smallest cell size in } N_i \text{ (region } i')$
5. *Introduce an edge from N_i to N_j for every possible cell-to-region assignment,*
 $\forall i \in N_i, j \in N_j, \text{Cap}(e_{ij}) = 1$
 $\forall i \in N_i, j \in N_j, \text{multiplier}, \mu_{ij} = \text{size of cell } i$
 $\forall i \in N_i, j \in N_j, \text{Cost}(e_{ij}) = \text{Cost of moving cell } i \text{ to region } j$
6. *Introduce source node s , with edges such that*
 $\forall i \in N_i, \text{Cap}(e_{si}) = 1$
 $\forall i \in N_i, \text{Cost}(e_{si}) = 0$
7. *Introduce sink node t , with edges such that*
 $\forall j \in N_j, \text{Cap}(e_{jt}) = f(i', j) = \text{MAX}(\text{Smallest}(N_i), f(i', j)), \text{ If } f(i', j) > 0$
 $0, \text{ Otherwise}$
 $\forall j \in N_j, \text{Cost}(e_{jt}) = 0$

End

\forall : Notation represents the meaning "For every element"

\in : Notation represents the meaning "Element of" (a set theory notation)

Figure 11